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Conserving a Watershed.

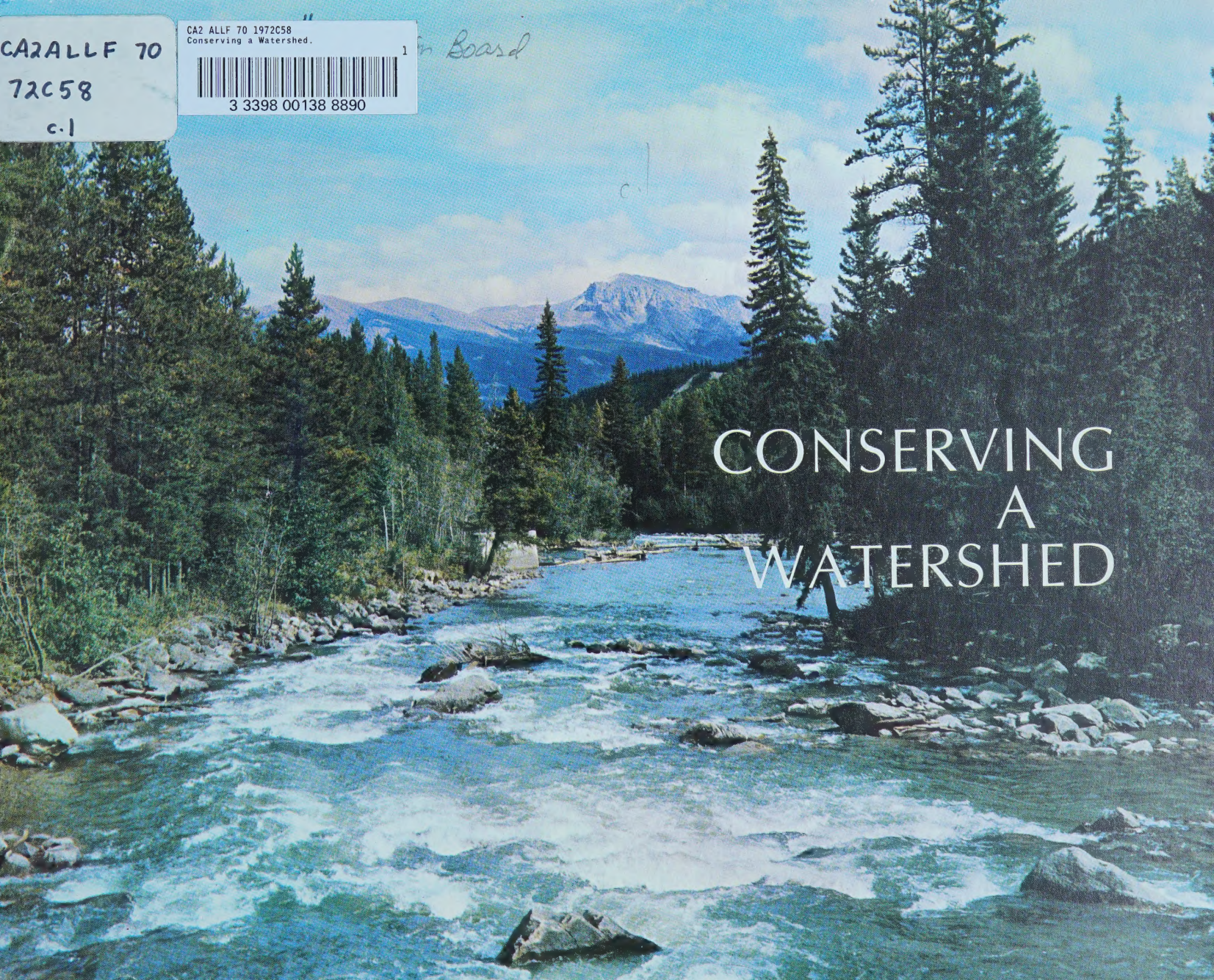


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CONSERVING A WATERSHED



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CONSERVING A WATERSHED

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Produced by Eastern Rockies
Forest Conservation Board
with the assistance of
Alberta Department of
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FOREWORD

"Conserving a Watershed" intends to give the reader a clear idea of the importance of the watershed of the Saskatchewan River system on the east slopes of the Rocky Mountains in Alberta, in providing water to the people of Canada's prairie provinces. There are other natural resources there, besides water, and the management system applied aims to make use of all of them. Problems of multiple use and some management principles are explained.

In view of the importance of the Saskatchewan River in supplying water to all three prairie provinces, the Governments of Canada and Alberta agreed, in 1947, to cooperate in the protection and administration of about 9,000 square miles of mountain and foothills watershed, known as the Conservation Area. A joint body, the Eastern Rockies Forest Conservation Board, was established to give effect to the agreement. This booklet draws upon over 20 years of experience and study in managing a headwaters basin which yields water, wood, forage, wildlife, recreation and mineral and petroleum products.

INTRODUCTION

Conservation means many things to many people and it applies to many situations. In this booklet the concept used is that of the best use of the land resources and at the same time making sure that all renewable resources remain for the benefit of future generations. This is contrary to the idea of "hands off" or non-use of a forest and its resources. The term "preservation" might be applied to that type of management rather than conservation. Conservation then, involves the planning of wise use, and the protection of the resources.

The natural resources of forest lands may be classed as renewable and non-renewable. Renewable resources are those which, if given the right environment, will reproduce themselves. A stand of lodgepole pine is a good example. When the trees are cut for lumber and the slash containing seed-bearing cones is left on the ground, and other favorable conditions maintained, a new stand of pine will grow up. Other renewable resources of the area, besides wood, are water, wildlife, grazing and recreation. Non-renewable resources are those like coal; when the supply is used up the resource is gone.

THE CONSERVATION AREA

The Conservation Area extends along the foothills and mountains from Waterton Lakes National Park in the south to the divide between the Brazeau and Athabasca rivers in the north, and skirts the eastern edge of Banff and Jasper parks.

The area is hilly to mountainous, rising from about 4,000 feet above sea level to over 10,000 feet. The summer climate is much cooler than the prairies and more rain falls. In the lower valleys it is only slightly cooler than on the prairies but in the high country, temperatures are much lower. Frost may occur and snow may fall on the mountains in every month of the year. Nights are always cool. Winter temperatures are seldom much lower than on the prairies except high on the mountains. Much more snow falls in the





mountains and both rain and snow increase with elevations. The lower foothills and valleys may receive about 20 inches of moisture per year, which is only a little more than the adjoining prairie, while the highest areas at the very headwaters of the rivers receive as much as 60 inches of water (as rain and snow).

The topography changes from rolling hills in the east to precipitous mountains along the continental divide. Slopes are generally steep. The soil mantle is relatively deep in the valley becoming shallower toward the mountain tops where the peaks and steep slopes are almost bare rock.

The main vegetation is forest, extending up the mountains where there is sufficient soil, or to treeline at about 7,000 feet above sea level. There are also grassy slopes, meadows, muskegs, and areas of low brush and bare rock.

Glaciers which filled the mountain valleys millions of years ago have carved and moulded the surface. The large valleys are U-shaped with cirques at the heads of the valleys, often containing small lakes. Great quantities of rock, soil and gravel have been left by melting ice as mounds or as outwash. Some remnants of the ancient glaciers still remain, such as in the Columbia Ice Fields.

River Valley and Front Range.

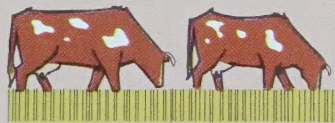


RECREATION
FOREST ENVIRONMENT
REST AND RELAXATION



TREES
HOLD SOIL, SLOW
SURFACE WATER RUNOFF,
PRODUCE WOOD

WHAT WE GET FROM FOREST LAND



FORAGE PLANTS
HOLD SOIL,
SLOW SURFACE WATER
RUNOFF, PRODUCE FOOD
FOR ANIMALS



WATER
IRRIGATION, POWER,
DOMESTIC, INDUSTRIAL,
STOCK-WATER, RECREATION

GOOD WATERSHEDS
HAVE FEW FLOODS,
PRODUCE LITTLE SEDIMENT,
PROVIDE PURE WATER



WILDLIFE
PLEASURE WITH
ROD, GUN,
CAMERA, BINOCULARS

RENEWABLE FOREST RESOURCES

In the early days of settlement of southern Alberta the forests of the east slopes of the Rocky Mountains played an important role. Many of the first houses were built of logs hauled long distances into the prairie country. When the open range was fenced and homesteads were taken up, many of the fence posts were brought from the hills. When the railroads were pushed across the country cross ties were cut in the mountains and foothills. In 1910, the east slopes, outside the national parks were set aside as a Forest Reserve, most of which is now included in the Conservation Area. The primary purpose was to reserve these lands for the production of a supply of wood. However,

it was recognized that this land also produces forage, water, wildlife and recreational opportunities. Coal, other minerals and petroleum products were known to exist underground.

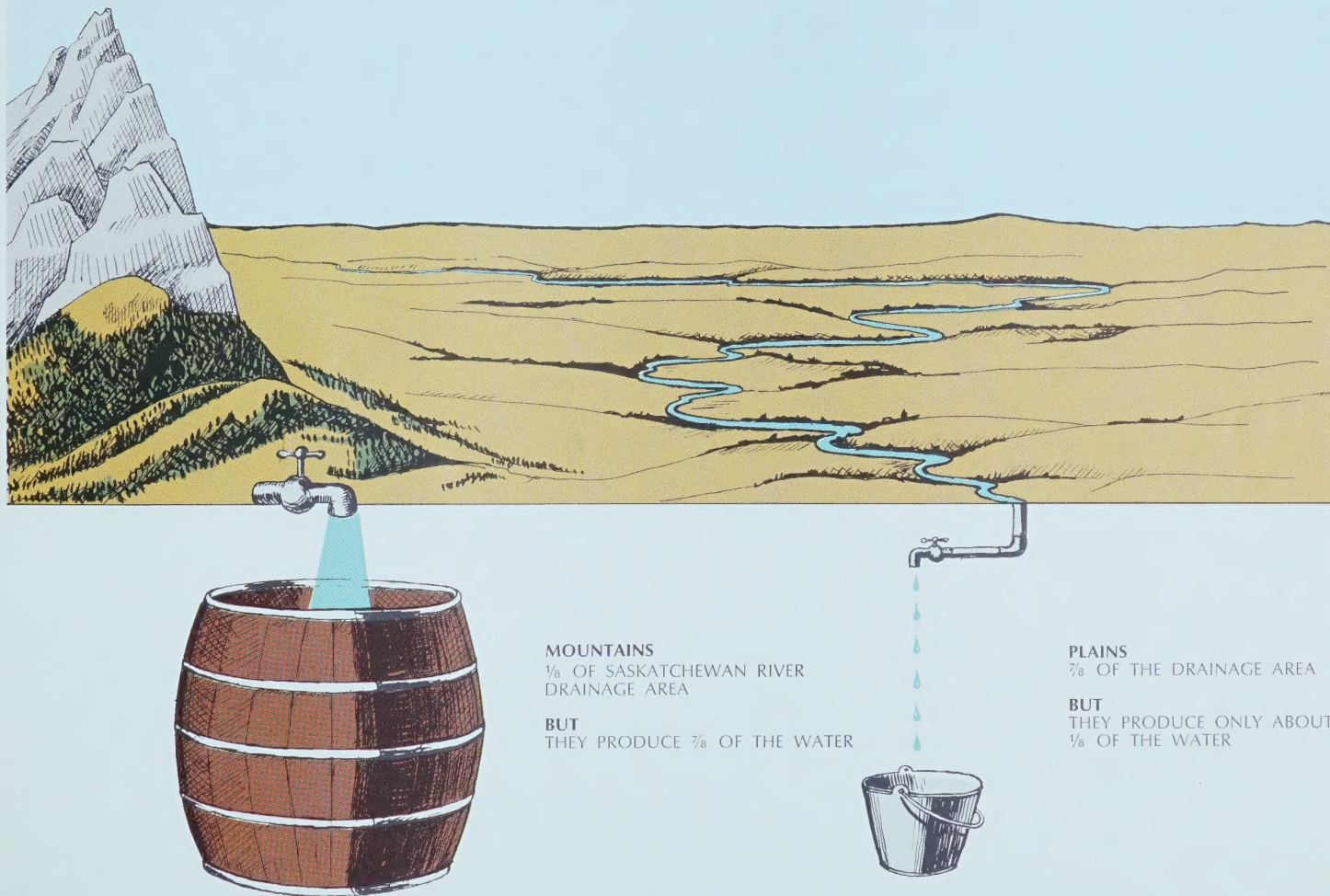
Although nobody worried about a water supply back in 1910 we have now come to realize that it is the most important product of the Conservation Area. Nor was there much time for recreation in those days, but now thousands of both city and country dwellers go to the hills and mountains to seek respite from the pressure of modern life. Not all the mountain country is covered by trees and much of the other vegetation is valuable as forage for deer, elk and domestic livestock. The clear streams and lakes produce fish for food and enjoyment. It can be said, then, that we look to the east slopes of the Rockies as supplying some valuable resources for our modern day life — water, wood, forage, wildlife and recreation — which cannot be found in the populated plains country.

THE WATER RESOURCE

In Alberta, most of the water in the rivers comes from the Rocky Mountains. Although the Saskatchewan River is a prairie river, with only the upper headwaters lying inside the foothills and mountains, most of the water flowing in it comes from the Rockies. Only about 12 per cent of the Saskatchewan basin lies in mountains, but about 87 per cent of the total annual flow comes from the Conservation Area and the National Parks.* We can therefore see that an important function of the mountain land is to produce water.

*A small part of the Saskatchewan River rises in Glacier Park in Montana.

RELATIVE WATER YIELD FROM MOUNTAINS AND PLAINS

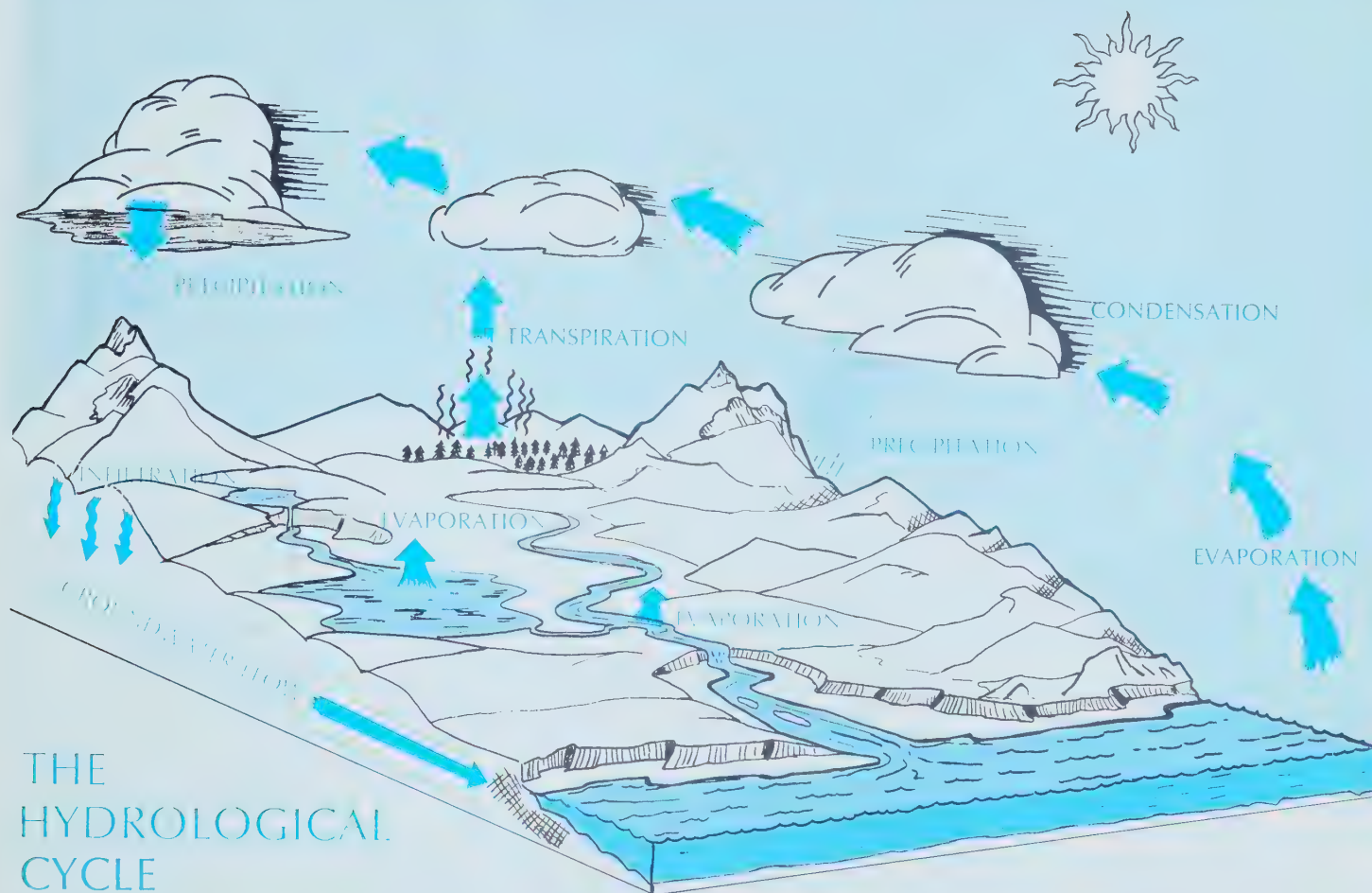




It is easy to understand the source of our rivers when we look at the hydrologic cycle as it applies here. The cooling of the air masses from the ocean as they rise over the mountains causes storms, either rain or snow. Rain and snow in the high country are abundant but the loss from evaporation and transpiration is light because of a cool climate. The Castle River basin in the Crowsnest Forest, for instance, has an average fall of rain and snow equal to 45 inches of water. The loss by evaporation and transpiration is about 18 inches, leaving as much as 27 inches to flow out in the river or as ground water; that is, almost 60 per cent of the moisture which falls on the basin becomes available in the river. Other streams of the east slopes do not yield as much as the Castle River but the run-off is in the order of 40 to 50 per cent. The Elbow River, for instance, yields only about 43 per cent of the entire precipitation that falls on the basin.

Not only do mountains receive more precipitation than the prairies but much more of it falls as snow and is thus stored in the snowpack as a great reservoir awaiting the heat of spring and summer to release it. Well over half the total precipitation falls as snow. Although the snow at lower altitudes melts in the spring, much of the deep snowpack in the subalpine and alpine zones remains into the summer. The melting of this snow and the summer rains supply the many permanent streams and replenish ground water which supplies the streams over winter. Snow is an important element in the hydrology of mountain watersheds.

Up where the rivers begin.



THE HYDROLOGICAL CYCLE

The movement of water – from the ocean to the clouds, overland by the force of winds, earthward as rain or snow, and thence back to the sea – makes up the hydrologic cycle. The processes involved are: evaporation from water and ground surfaces by the sun's energy, lifting of the moisture to the clouds by convection currents, condensation to fall as rain or snow (precipitation), enter the earth's mantle by infiltration, or moving overland. The water reaches the sea in rivers or by aquifers in the earth. Some moisture is short-circuited back to the clouds by evaporation before reaching the earth and much returns to the atmosphere through the plant leaves by transpiration.

THE WOOD RESOURCE

Wood, with its many by-products, is one of Canada's greatest natural resources and, along with wheat, minerals, petroleum products and tourist attractions, largely determines the economy of the country. However, wood from the Forest Reserve of the east slopes has ceased to be the major product and the management of the land in the future will be more for the yield of water, the recreation enjoyed, and fossil fuels, than for the wood produced. Mainly because of climate, tree growth is slow. Many of the mature spruce trees being harvested for sawtimber are 200 to 300 years old and it takes over a hundred years or more to grow a new tree to a suitable size for sawing into lumber. Even to produce pulpwood requires 80 years or more.

Even so, the Conservation Area supports some sawmills which cut mostly spruce (Englemann and white) and lodgepole pine into lumber. Some Douglas fir also is harvested. Other trees of less value are black spruce, alpine fir, larch, aspen poplar, balsam poplar and white birch. Small numbers of selected logs are cut into plywood and small diameter pines are made into posts and poles. There is much timber suitable for pulpwood but there is no pulp mill operating on the Conservation Area and only a small amount of pulpwood is shipped out. The desirability of a large pulpwood operation in the Area is under intensive study.

Logs from subalpine forest are often hauled to sawmills in the valley.



THE FORAGE RESOURCE

Much of the area not covered by trees is covered by grass, broad leaf herbs and shrubs, or a mixture of these. Many of the forest stands have an understory of grass, herbs and shrubs. These constitute a resource which supports a population of wild grazing animals, as well as a controlled number of domestic animals — mostly cattle but some horses and sheep.

THE WILDLIFE RESOURCE

The Conservation Area has a varied and interesting wildlife population, although the total numbers are not great. The forage under the open stands of trees, in the forest openings, on the meadows and open slopes support deer, elk, moose, mountain sheep, goats and caribou. Rodents, such as squirrels, chipmunks, mice, beaver, marmots, and the interesting pika or rock rabbit, live in the forests and on the open mountain sides. Predators, such as coyotes, wolves, cougars and lynx live upon the plant-eating or herbivorous animals. Bears, both black and grizzly, eat both plants and animals. Some of the animals yield furs of value but trapping for furs in the mountains has almost ceased.

Deer, elk and moose are more abundant in the foothills and valleys where feed is more plentiful.

The forage that grows on our mountain lands may be as valuable as the wood.





Elk migrate to the high mountains for the summer. Bighorn sheep and mountain goats live in the alpine regions, often on steep crags. The mountain caribou is found only in the northern part of the Conservation Area.

The wildlife adds greatly to enjoyment of the mountain scene both for hunters and for those who go to enjoy the environment. However, animals are not seen frequently because they are not generally abundant and they shun people. But this does not mean that they have been exterminated. The elk, bighorn sheep and mountain goats are back in the alpine country in summer and deer seek cover while the young are small. Cougars, wolves, lynx, mink and such interesting animals are wily creatures and seldom let themselves be seen. Bears, when plentiful enough to be seen often are a nuisance and may be a menace to life. Grizzly bears are not numerous and stay mostly in the back country away from human activity.

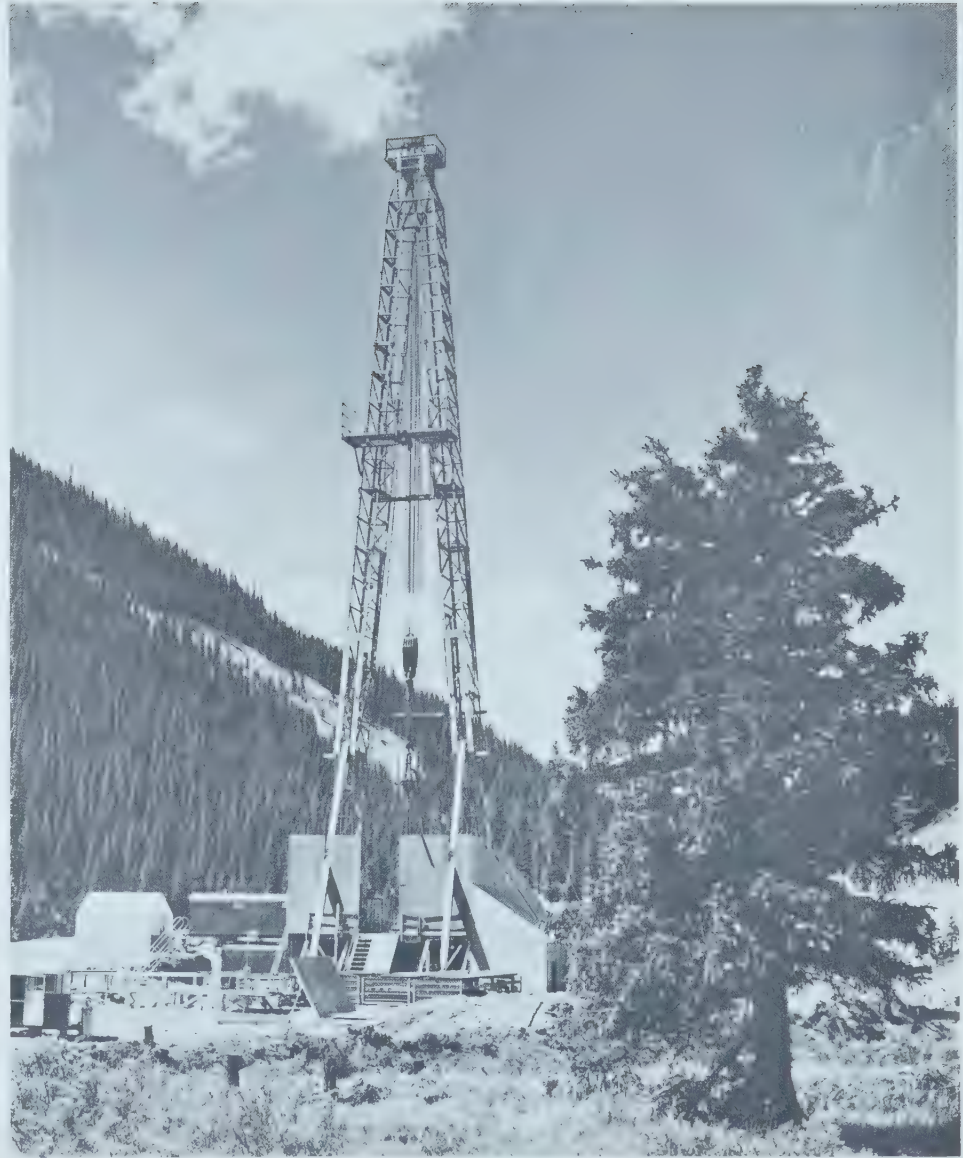
The fish of the mountain lakes and streams grow and reproduce rather slowly because of low temperatures and lack of abundant food, but they are found in most waters and are of excellent quality and offer a very desirable form of recreation. Fishing is the most practised sport in the Conservation Area. The wildlife of the mountains, although in only moderate numbers, is a resource of considerable value. It supplies food from fish and game animals, but probably more important, it offers a form of recreation to the hunter and fisherman and to those who enjoy observing and photographing nature.

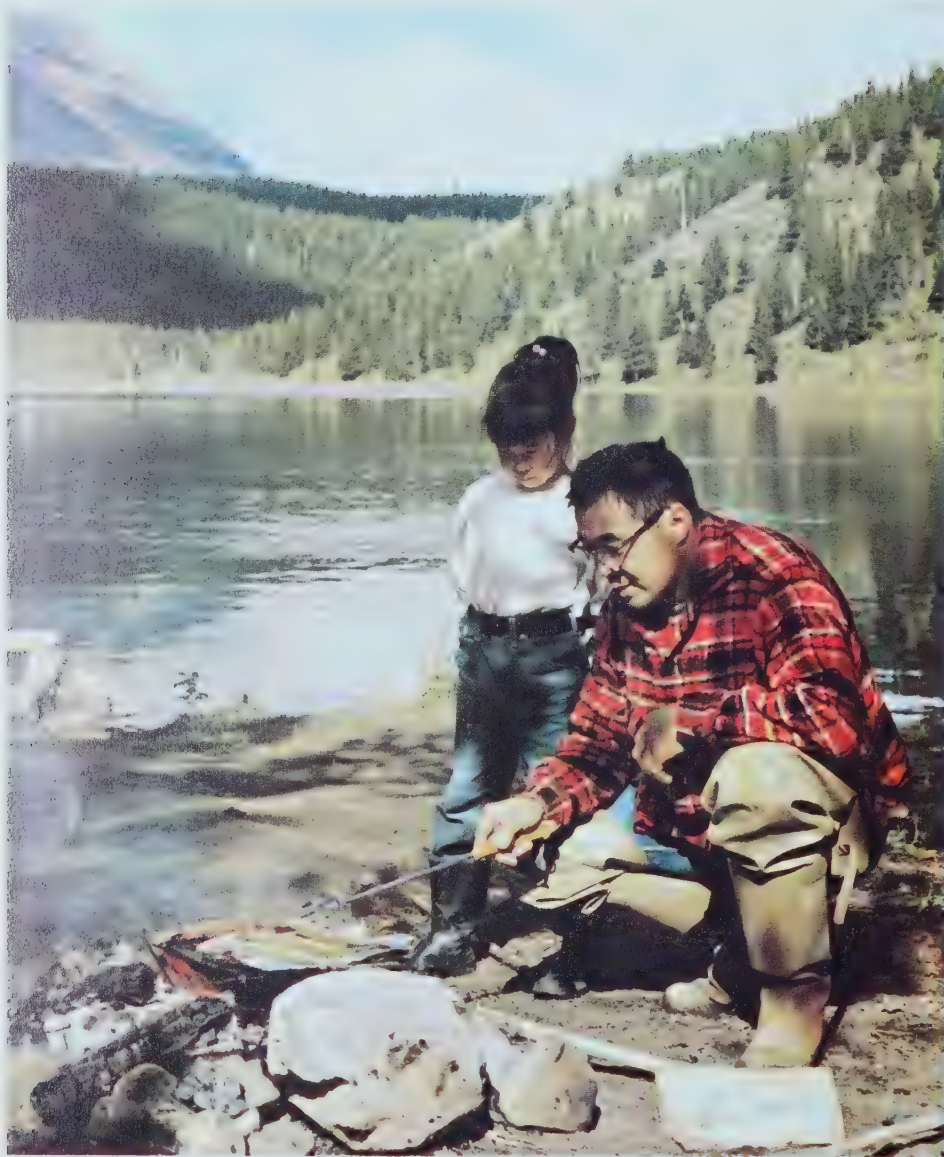
Wildlife, like this bighorn ram, attracts tourists and adds to the recreation of the residents.

NON-RENEWABLE RESOURCES

Coal, oil and gas, building stone, limestone, gypsum and other minerals are found in the Rocky Mountains. Gas and oil wells inside the Conservation Area are contributing significantly to the economy of the province and coal is now taking on new importance. The first oil wells drilled in western Canada were in the mountains and coal and other minerals have been mined there since long before the Forest Reserves were established. These activities are not new but a new interest in them has developed and they form part of the wealth of our country.

Oil and gas wells in the foothills and mountains supply large volumes of petroleum products.





THE RECREATIONAL RESOURCE

When one mentions recreation in the hills and mountains it means different things to different people. To one it may be fly fishing along a turbulent mountain stream, trolling a lake, stalking a bighorn sheep in the vast alpine wilderness, driving the roads in hunting season with hopes of bagging a deer or elk, camping near a clear, fresh stream, going by pack outfit to the little-seen wilderness country, drinking in the beauty of the sun-drenched valley, hiking over a rugged mountain-top trail, skiing on steep snow-covered slopes, power tobogganing over mountain trails, or just driving through the country. The nature of the land which satisfies these desires is the recreational resource. It is not like the timber resource which can be cut down, sawn up and sold. It is intangible but nevertheless quite real. And, in our day of increasing leisure time, good transportation and money to spend, it has great value.

Outdoor family recreation fills an important need in our modern way of life.

MANAGING THE RESOURCES

The forest resources include material products such as wood, and also intangible values like beautiful scenery, all of which may be utilized both for economic gain and the enjoyment of people. But until resources are used these values are not real but only potential. A seam of coal lying untouched in a mountainside or a beautiful inaccessible lake is of no value to people until the coal is mined and used in industry or until people can reach the lake. However, utilizing one resource may cause damage to another; for instance, mining the coal mentioned above may destroy the aesthetic and recreational value of a lake. As a result the net gain may be negative.

Management of the resources of the Conservation Area is aimed at making use of all of them without destruction of any. The approach may be called multiple-use management, multiple-resource management or integrated resource management. Whatever it is called the aim is to manage the land so that all resource-use is coordinated to give the greatest total benefit to the people. There are some concepts that are helpful in understanding resource management and these are discussed below.

MULTIPLE-USE

The full value of our mountains is attained when all the resources which we have mentioned are being used and the Conservation Area is being managed for its many resources. For instance, a typical high mountain valley may support a mature spruce forest, supply range for a herd of elk and some deer and moose, have at its head a beautiful lake drained by a creek that supports fish; and have, below the surface coal and natural gas. The aim is to use the timber, the forage, the wildlife and fish, the recreational possibilities, and the gas and coal in such a combination that the total value gained will be greater than if only one resource had been used. The recreational use of the valley might be greatest if all other activities (mining, well drilling, lumbering, etc.) were excluded but the total good to society may be much less. However, care must be taken to see that using one resource does not destroy another. Mining, if uncontrolled, could destroy the recreational resource, but multiple-use management allows the use of both and aims at avoiding serious damage to the other.

GREATEST GOOD TO GREATEST NUMBER

When trying to use all of the resources there are sometimes conflicts of interests, such as between lumbering and recreation. Selfish interests should be avoided and the decision made should yield the **greatest good to the greatest number**. An example of this might be found in the valley mentioned above. The best timber might be found on the lakeshore which is also an ideal location for a delightful camping area. Harvesting the timber there would destroy the natural characteristics which make it a good camp. Therefore, a decision must be made in favour of one or the other of these two uses which would give the greatest good to the greatest number of people.

The lumber from the small areas required for recreation would probably be some of the best in the valley but the amount would not be great enough to seriously affect the economic health of the country. The logger could still operate without this timber. On the other hand this place may be one of the few ideal camping areas where many people from a nearby city could camp and fish. Likely, in this case, the greatest good to the greatest number of people would result from withholding this location from the timber berth and allowing its use as a campground.

SACRIFICE

Sometimes it is necessary to sacrifice a product or a value in order to attain the greatest total good. A coal seam extends from the upper Kananaskis to Canmore and passes across a watershed research basin known as Marmot Creek basin. This is a well-developed research basin in which much money has been spent and which may yield valuable information for managing mountain watersheds. To prohibit mining in this basin would mean leaving some valuable coal unused but it makes good sense to sacrifice the coal in favour of the greatest value — better watershed management in the future.

PRIORITY

In making management decisions, one resource may appear to have greater value than all others. When this is so, the more valuable resource may be given priority over others. For instance, on the east slopes of the Rockies, water to serve the prairies is so important that water has been given priority or first place in resource management. When conflicts arise between watershed values and other values, watershed values have first place. This is true in general over the east slopes but in some small areas, such as in the case of the campground on the lake mentioned earlier, recreational or other uses are given priority.

INTEGRATION

In management of resources it is important that all uses are integrated or tied together into one plan. To accomplish this each use is not planned separately but a plan is drawn for all uses on a land unit. For instance, in the Conservation Area the management units are watersheds or river basins and all resources are considered together in each basin. The Oldman (North Fork) River basin is a conservation unit and water production, grazing, timber and recreation are all managed as the resources of that land unit. If watershed management, timber management, recreation management and range management are considered

separately there is lack of unity, and conflicts will not be resolved. The greatest total good, both in goods and services, from all resources is the aim of integrated management.

There was a time when any efforts to protect and conserve the forest resources were a matter of legislation and enforcement of regulations. For instance, a timber berth was let to an applicant and the methods he employed were his choice as long as he stayed within the regulations in force. These were mostly prohibitions. Neither did the Government plan the use of the timber resource, nor was the operator required to do so.

The establishment of the Eastern Rockies Forest Conservation Board in 1947 marked the beginning

of planned conservation of the forest resources on the east slopes of the Rockies; and certainly not before it was needed. Government agencies now put forth much effort to learn about the land resources and to manage them for the good of the people, not only those now living but for future generations. Companies which are granted use of the resources are required to plan the use of those resources assigned to them. The principles of land management mentioned earlier are being applied more fully each year. The management of each of our mountain resources is discussed below and although all must be considered together, each resource is dealt with separately for convenience.

WATERSHED MANAGEMENT

Industrialization of western Canada and the increase in population have created a need for water not known in the past. The population of Calgary has increased more than fourfold in the last 20 years and the average daily consumption has increased nearly sixfold, that is, from 18,867,000 gallons in 1945 to 107,730,000 in 1968. Industrial processes, which are increasing in Alberta, use much water. To refine a gallon of gasoline requires more than 10 gallons of water. To produce a ton of steel requires 65,000 gallons and a ton

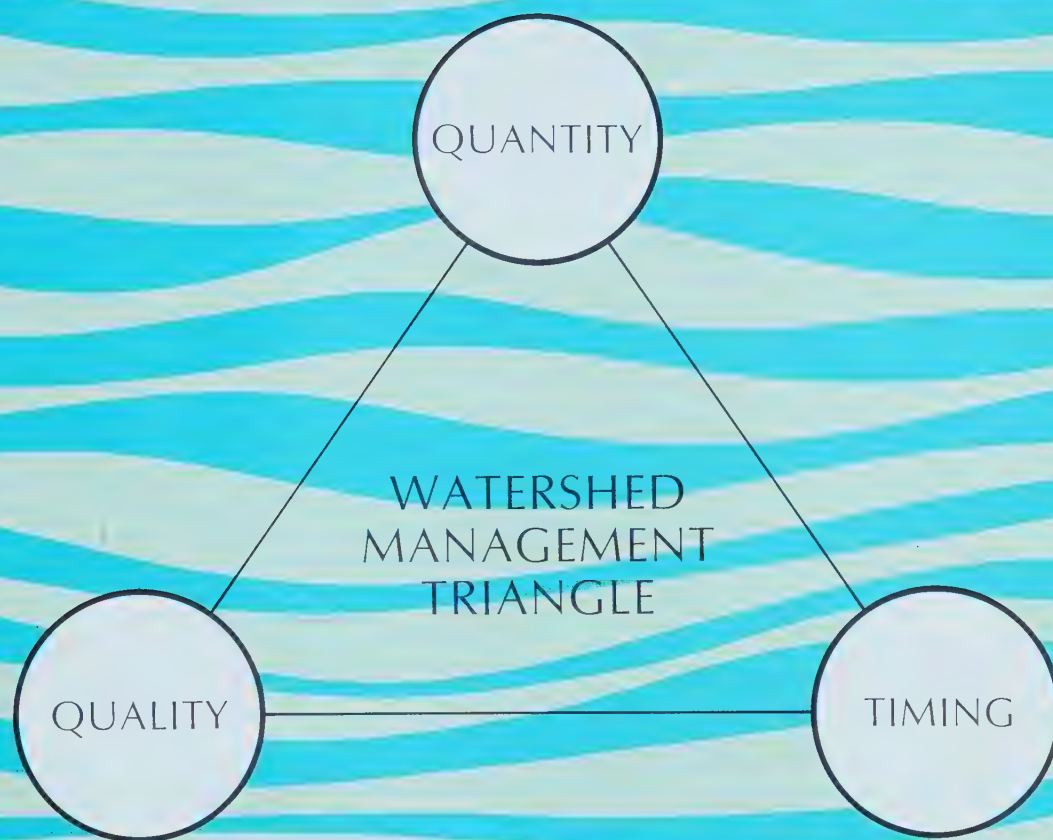


of cement 750 gallons. Besides the water used in the refineries and factories a large stream is required to dilute the effluent carrying the waste materials from the sewage plant and factories of a city. To irrigate an acre of land requires up to 272,250 gallons yearly. The demand for water in the form of lakes, streams and swimming pools for modern living is great. The importance of water puts great value upon the mountain lands from which most of it comes. Although the pinch of a water shortage has not been felt in Alberta this can be expected. It is very fortunate that this need has been foreseen and that steps have been taken to protect and manage the watershed before great damage has occurred, and before a water shortage has been felt. Many parts of the world are not that fortunate.

In watershed management we are concerned with three factors: (1) quantity; (2) quality; and (3) time of flow. With an increasing need for water the total amount which we can squeeze from the mountains will some day be needed. However, if the streams run muddy with sediments and other impurities the water is of little value. A smaller quantity of pure water may be more desirable. If too much water arrives at one time we have flood conditions which cause damage and loss of life, and during the rest of the year there may be a shortage. The ideal is the greatest quantity of clear water that can be produced in streams and springs which flow uniformly throughout the year. This is never entirely attainable but in management we strive toward that end and set goals of quantity, quality and timing which may be reached.

All water which flows in the streams from the mountains first falls on the land as rain and snow. It flows directly overland to a stream or filters into the soil and then appears as seepage, springs or artesian water. (See Hydrologic Cycle). If there was no vegetation on the mountains the rain and the snowmelt would mostly move directly to the streams, carrying soil with it.

Water — clear, pure and plentiful — is the aim of management of the mountain watersheds.



One feature of watershed management may be the building of dams and other engineering structures, but these can be most efficient only when there is upstream management on the watersheds which feed the reservoirs. Heavy loads of sediment in the streams fill the reservoirs and shorten their lives. Floods and low flows make the structures less efficient.

The biggest problem in maintaining the quality of the water on the mountain watersheds is with soil and related material being washed into the streams and being carried as suspended sediments. Pollution by chemicals or biological impurities may enter the streams in the mountains. Mines, for instance, may contribute soil, acids and coal to the streams. Heavy recreational use of a valley may pollute the water with human wastes. However, the major management problem associated with water purity in our mountains is that of keeping the soil in place.

A good plant cover, whether of trees or ground vegetation, protects the soil from the erosive effect of falling rain or running water. A plant cover along with a layer of dead leaves, needles and decaying plant material allows the moisture to filter into the soil where it may move laterally toward the stream, percolate downward to become ground water, or remain in storage in the soil. A well-vegetated watershed is resistant to erosion and helps to avoid floods and shortages by slowing up the movement of water to the streams.

To make sure that streams run clear with high-quality water and to provide good fish habitat we try to keep a healthy plant cover to hold the soil in place, whether it be trees, grass or other vegetation. Logging, over-grazing, recreational activities, road building and any other land use which bares the soil may cause dirty water and subsequent damage to the fish habitat. Of these, road building is the most serious offender. In the Conservation Area the removal of tree cover does not cause

Poorly located trails, road and seismic lines may erode into gullies with sediment often silting up a stream.



serious erosion because of ground vegetation and duff layer left under the trees, but the roads and skid trails have caused serious damage where precautions were not taken.

Management practices that are applied on the area fall into three classes: (1) watershed protection; (2) watershed improvement; and (3) restoring good conditions where damage has occurred. The watersheds are protected by regulations and supervision which control the land use. For example, logging companies must locate roads away from streams and leave a buffer strip of uncut trees between the road and the stream. Where damage has occurred from the building of skid roads and trails, these must be restored at the end of the logging operation. Cross ditches to lead the water into stable watercourses and re-seeding to get a cover of plants on the bare soil are required.

It is necessary to protect watersheds against damage with almost any kind of use, be it logging, grazing, recreational activities, exploring for minerals and petroleum products, mining or drilling for oil and gas. Road construction, whether for general access, logging, mining, oil exploration or any other purpose, upsets the normal movement of water through the duff layer and soil and causes sediments to collect in the streams. In road building in mountain country large cuts and fills must be made, leaving extensive steep slopes exposed to erosion. Water is collected in ditches and often runs down long slopes and directly into the stream, carrying silt and pollutants with it.

Grazing, whether by domestic animals or wild game, may reduce the plant cover to the point where soil is not well protected. However, where slopes are not too steep, where the ground carries a good plant cover, and where grazing is moderate, no damage is likely to occur. On the other hand, over-grazing and trampling, especially by elk on high steep slopes, can cause soil movement, eventually resulting in gullies and streambank erosion. The watersheds may be protected by avoiding over-grazing. This is fairly easy to accomplish with



Clear streams are ideal habitat for trout and also supply pure water to the cities below.



domestic livestock because it is easy to regulate and control the number of animals, where they graze, and the season of use. This is more difficult with elk and other wild ungulates. However, regulated hunting is used to keep the animal population down to levels where over-grazing is avoided.

Coal mining and oil and gas exploitation are among the most serious threats to watersheds. Although the area of land affected is small, if poor methods are used, damage to stream channels and water pollution can be serious. Seismic lines, roads, wells or mine sites, and strip mine pits destroy the plant cover and disturb the soil. This leaves the ground subject to water erosion and considerable damage to stream channels has resulted in some limited locations. Slack coal deposits in Crowsnest Lake resulted from strip mining and careless hauling of the coal. Pollution by dissolved materials may also occur, as occurred where acid water flowed from a mine into McGillivray Creek. Oil, drilling mud, and other waste materials from oil drilling have been washed into

Coal seams are often near the surface in the mountains and can be extracted by stripping off the overburden with heavy machinery.

nearby streams. However, by the use of careful methods most of the damage can be avoided. A major function of watershed management is to see that watersheds are protected against these hazards.

Coal can be mined and oil extracted with little damage to watershed if proper precautions are taken. There are examples where mining and drilling have been done with little damage, but on the other hand considerable damage has occurred in the past with little attention to the land resources affected. Most of the oil and mining companies are now showing concern for conservation and are willing to apply protective measures in their operations.

There are, however, certain places in the mountains where it is impossible to mine, or drill a well without doing serious damage to the water resource. The location of a coal mine on the bank of Racehorse Creek is a case in point. If we are to properly protect the mountain watersheds, it will be necessary to prohibit drilling or mining on the extremely hazardous sites. In several cases oil companies have recognized the hazard and have agreed to change a selected wellsite to a location where the chance of damage is less.

Even recreational use places some stress upon watershed values. Roads and trails for access to camping areas do cause temporary damage which may be long-lasting if proper methods are not



Damaged watersheds can be restored. Here a 50-acre eroding scar was healed by establishing a grass cover by mulching and hydro-seeding.

used. Trampling at campgrounds and wherever people and their vehicles congregate causes limited watershed damage.

Where damage to the land occurs from using a resource it is often possible to restore good conditions. Where the forest or plant cover has been removed it can be restored by re-seeding or planting. Unsightly scars can be re-landscaped. Erosion can be checked by cross-ditching roads and seismic lines or restoring drainage so that water reaches the well-vegetated natural channels. Some experiments to restore damage have been successful such as at Barrier reservoir shown in the picture. It is possible to improve natural watersheds. Research into this field is under way on the east slopes such as in the Marmot Research Basin in the Kananaskis valley. It has been demonstrated that the removal of about half a stand of spruce and pine, cut in strips, increased the flow of water in the streams by about 30 per cent. Cutting trees that grow along streams, with their roots at the water table, also increase water yield. Cutting trees in a prescribed pattern of blocks and

strips along a slope has been found to delay snow-melt and increase water yield. Snow-drifting contrivances have been used to pile snow in deep drifts where they melt slowly the next summer. In some places in the United States where water is in short supply, tree and brush cover have been replaced by grass to increase water yield. Although there are no plans in Alberta to remove tree cover for increasing water yield, it is known that the cutting of timber does increase the flow from our mountain watersheds. In the future we may be carrying out work to improve the yield and time of flow.

When we realize that the use made of mountain lands may cause serious damage to watersheds we realize that protective measures are important. Fortunately, there are methods of using the wood, the forage and the mineral resources with little damage. And when damage has resulted there are ways of restoring good conditions in most cases. When all the modern technology of protection and restoration are applied we can call it good land management.



NATURAL EROSION

All erosion, however, is not caused by man's activities. There is natural or geologic erosion. It is the process by which mountains are worn down and the deep soils of the valleys are built up. We cannot control natural erosion but we can avoid accelerating it. Recognition of natural or geologic erosion and differentiating it from man-caused or accelerated erosion are important in watershed management. This is sometimes difficult to do, and often a muddy stream may be blamed on man's activities when it is a natural process. The Sheep Creek, for instance, has incised itself into the deep valley fill which was deposited in the past. This fill is shale and clay and erodes away easily with each heavy storm, regardless of man's activities. On the other hand some operators, looking for a way to justify their careless work, blame the sediment in streams on natural erosion.

All soil erosion is not caused by man. Natural or geologic erosion caused this "hoodoo."

MANAGEMENT OF THE WOOD RESOURCE

We have spoken of wood as a renewable resource but the forest will renew itself only if properly managed. It is true that some kinds of tree cover will grow back on natural forest lands without the help of man, but it may not be the crop of trees which will serve our purpose best. The kind of management which is being applied on the Conservation Area is spoken of as sustained yield. A complete inventory has been taken of the wood resource and of its rate of growth. A plan of harvest has been drawn up with an allowable cut for each year so that a new crop is growing at the rate at which the mature trees are being removed. Methods of cutting and land treatment are being applied so as to speed up the regrowth of the tree crop. Spruce trees are often cut in strips or patches to allow seed from the remaining strips to germinate on the cut-over patches. With lodgepole pine, which has seeds locked in the cones, the slash (branches and tops) is scattered over the land so that the sun will open the cones and thus seed the area. Often the land is scarified with a bulldozer to remove vegetation and expose the soil to receive the seeds. When natural regrowth does not occur it is necessary to plant young trees and more planting is being done each year.

The wood resource on the Conservation Area is limited. Tree growth in our mountains is slow because of lack of fertility in the soil, a short growing season, cool climate and occasional summer drought. Even under management a new crop of trees suitable for a pulp mill would take 80-100 years to grow and a crop of spruce sawlogs takes 100-150 years.

Protection from fire is an important part of timber management. Although the wood is not often burned up the trees are killed and a great waste of wood occurs. There may also be loss of wildlife, damage to watersheds, and a beautiful green forest may be turned into an ugly waste. Fortunately, fire in our mountains does not permanently destroy the forest. The seed cones of the lodgepole pine which are kept closed by a gum or resin are opened by heat and the seed

released. A forest fire in a pine forest (and almost all of our forest has some pine in it) releases many seeds which sprout after the fire to give a new crop of trees. Often the number of seedlings is too great and a thick mass of young trees covers the ground. We sometimes call this "dog-hair" because it suggests the expression "as thick as hair on a dog's back." Very dense stands of pine often become stunted.

In any case, the young seedlings grow very slowly, especially if they are close together or have to compete with grass, weeds or brush. Sometimes one may look at a mountainside several years after a fire and think that there are no new trees growing when actually they are there but hidden by other growth. Even after ten years young pine and spruce may not be more than three or four feet high.

All effects of fire are not bad. It is part of the natural environment. Aged, decadent stands of forest are removed by fire to allow for new growth. Disease, rot and insects, typical of decadent stands, are destroyed. The new vegetation which follows a fire presents an ideal range for wildlife. It is the uncontrollable aspect of fire that makes it a destroyer instead of a useful tool of management. Planned and controlled burning can be used in timber management and the management of wildlife range.

Forests also are damaged by insects and disease. Fortunately, the east slopes have not suffered severely from these causes and no special treatments such as aerial spraying have been necessary. Good methods of harvesting, sanitation and maintaining growing stands of mixed species may prevent serious disease and insect damage.

People can and do cause damage to forest growth by trampling and compacting the soil in camp and recreation areas and by careless or wanton damage to the trees. This damage is not widespread but it becomes serious in camp and recreation areas where the forest is essential to the beauty and the comfort of such an area. Many forest fires are caused by the carelessness of campers and travellers and can be avoided.

Lookout men scan the forest for fires from towers like this one.



RANGE MANAGEMENT

The forage resource makes possible the herds of grazing wild animals in the mountains as well as supporting some domestic livestock. The productivity of the range and its condition determine the size of herds that can be produced, whether they be wild or domestic. The number of grazing animals is limited by the productivity of the range. As long as the number of animals does not exceed the capacity of the range the forage resource remains healthy and vigorous and the herd of animals also. But as soon as the population grows too numerous the range is over-grazed and loses its productivity. A plant that is grazed only moderately remains vigorous with a healthy root system but if continually over-grazed the root system declines and the entire plant loses its ability to produce plentifully. With a shortage of feed, animals begin to suffer malnutrition, and parasites, such as ticks and lung worms, have an advantage. A case of wild animals dying as a result of over-grazing occurred in the Castle River district. That district was closed to hunting as a game preserve. The elk multiplied until they were too numerous for the winter range. In the severe winter of 1946 hundreds died in one valley.

In this way nature keeps a balance between the animals and the range on which they live. When the animals become too numerous they die off by natural causes. However, the reduction in numbers by death does not occur until the range has been seriously damaged and its capacity to carry

a herd reduced. In some cases entire herds have been wiped out by hunger and disease and only after many years has the range become vigorous and healthy and a new herd returned. We sometimes blame the diseases which attack the weakened animals for causing death when the primary cause was lack of winter feed. When the bighorn sheep died off in the Castle River district in the early 1940's, until they were almost extinct, people saw weak and sick and dying animals and blamed the condition on the introduction of new diseases. More likely, the real cause was the destruction of their natural range by over-grazing. The over-population of elk caused them to move back into the high alpine ranges used by the bighorn sheep. At the same time domestic sheep were taken back into the same area. Under this condition large herds of bighorn sheep almost disappeared. Then with the reduction of the elk through cancelling the game preserve so as to allow hunting, and with the domestic sheep removed, the bighorn sheep herd increased until a good herd again ranges on the same area.

In the mountains of Alberta, where winters are cold and storms severe, good winter range is especially important. No matter how fat the animals may become in summer they cannot survive the winter unless they can find sufficient food. The deep snow of the mountains covers up the grass and most herbaceous plants, and animals may have to survive on tall shrubs or seek places where the wind blows the snow away and exposes cured grass. Localities, which produce the kind of feed which the animals can find in winter and where there is some protection from the storms, are called winter range. The amount of winter

range determines the number of wild animals which our mountain lands can produce.

Management of the range for cattle is well developed in the Conservation Area. Each grazing unit has a management plan which aims to make use of summer range not needed by elk and other wild ungulates, and to avoid use of or damage to the winter range. The carrying capacity of each unit is calculated and the number of cattle limited accordingly. Methods of handling the livestock are also set out in the plans requiring sufficient herding, salt ground distribution, and fencing to spread cattle and keep them from areas where they are unwanted. The number of domestic animals in the area has never been great and both the total number and the length of season have been reduced over the last 20 years.

Managing range for wild animals is more difficult. Much less is known about the carrying capacity of the mountain lands for elk, deer, moose, mountain goats and bighorn sheep. However, methods are being applied to balance the number of wild animals with the grazing capacity of the winter range.

The winter range can be protected and improved. In the pulpwood area near Hinton the cutting of spruce and pine in patches and strips improved the range and a marked increase in deer was noted.

Controlled burning, planting and spraying with herbicides can all be used to replace trees with shrubs and herbs for the animals to use. It may be that improvement of range for wild animals will be practised on the Conservation Area in the future.

WILDLIFE MANAGEMENT

The key to good wildlife management is good habitat or the environment in which the animals live. The scientists have a name for the study of the environment; it is ecology. To put this in its simplest terms it means where the animal lives, what he eats and what eats him. In order to manage the wildlife populations we must know how many young they can produce, what their food and living requirements are and what are their enemies and limiting factors.

A dense forest of mature spruce shades the ground and there is almost no undergrowth on which to graze. Grazing animals such as moose and deer must go elsewhere, but squirrels, rodents, and some birds such as the spruce grouse which live on the seeds of the trees, find it to their liking. Predators which eat these animals and birds can live there too. As a forest matures and the crowns shut out the sunlight, the grazing animals such as deer, move to the open woods where fire has occurred, trees have been cut, or where there are natural openings. Most animals prefer the fringe of the forest. This gives them protective cover from enemies and storms, and yet supplies feed abundantly.

The management of the wildlife is then a matter of knowing what animals and birds live in the

mountains, understanding their best environment and then setting about to keep the environment as favorable as possible.

With animals which we hunt we can keep the population from getting too numerous for its winter range by allowing more hunters to shoot animals. When the herd is kept in balance with its winter range the young are numerous and strong and the herd is healthy. The purpose of wildlife management is to assist nature in keeping healthy productive populations of animals in balance with the environment which each kind of animal needs. The wildlife manager takes inventory and estimates how many animals there are and whether they are increasing or decreasing. He also observes their range to see that it is not being damaged by overuse or other causes. The game biologists and managers employed by our governments are now applying the principles of management to our game animals. They try to arrange hunting seasons so that a herd of each game animal is equal to the capacity of the range. Then the natural increase of this herd is taken by hunters without depleting the herd.

Other kinds of wildlife need to be managed too. There are some scarce animals that need protection. Even the predators like wolves and coyotes need to be managed. They play an important part in the balance of nature.

No doubt, all of us would like to be able to drive into the mountains and see wildlife everywhere. This is not possible even with the best management. The limiting factors of severe long winters and small amounts of winter range for the grazing animals mean that the population of wild animals will always be relatively small. To try to build the herds up beyond the carrying capacity of the range is not conservation. Where this has happened the productivity of the land has been decreased and many animals have died of starvation in a long cold winter. We must be satisfied with a population of wild animals in balance with a tough environment.

Hunting — both recreation and a tool in managing big game.





RECREATION RESOURCE MANAGEMENT

There was a time when any recreational use of forest lands was incidental and required no management. People now have leisure time, automobiles and aircraft, money to spend on gratifying their wants, and a need to find release from the pressures of modern living. Outdoor recreation in the mountains serves this want and it is so much a part of the lives of city dwellers that there are throngs of people seeking to use all mountain lands, especially those near to our cities. For this reason, recreation ranks high among the uses of the Conservation Area, especially in parts near the cities of Lethbridge, Calgary, Red Deer and Edmonton. In the parts adjacent to these cities only watershed values rank above recreation.

When recreationists become numerous some control over their activities is necessary to avoid damage to the resource. If campers, picnickers and others are allowed to go wherever they wish and do as they feel inclined, the forest soon loses its recreational value. Recreational use tends to destroy the resource upon which it depends. For example, excessive camping destroys the grass cover, the shrubs, and eventually even the trees that make a location desirable as a camp. A beauty spot of nature can become a dusty, trampled maze of roads with stumps and dying trees.

Recreational use of the mountains may be put into three classes: (1) Intensive or Development;

(2) Multi-use; and (3) Primitive. The areas where development takes place are near cities and along roads. Commercial and government developments supply facilities for recreational use. The developed camping areas for tents and trailers, service stations, stores, ski lodges, motels and such creature comforts are found there. These areas are set aside and managed almost entirely for recreation with precautions taken for watershed protection.

However, the amount of land needed for intensive recreational use is not a great portion of the Conservation Area. Beyond these intensively-used areas is the big country where other uses of the forest land are being carried on — logging, grazing, mining or drilling for oil. This country also offers opportunities for hunting, hiking, fishing, driving, power tobogganing in winter, sight-seeing, berry picking, and camping in undeveloped campgrounds. People make use of these lands for recreation alongside of other uses. Government agencies attempt to maintain the land in such a way that it serves the recreational needs of people, while at the same time yielding lumber, grazing, oil and minerals to build up the economic wealth of the country. In most cases the recreational use can be enjoyed along with some other use and in some cases the commercial use may contribute to recreation. For instance, logging improves deer, elk and moose range and supplies roads for access by hunters. People are often interested in seeing a logging operation or a sawmill. The writer recalls a family trip on which the highlight was going through a pulpmill, and on another it was being held up by a herd of fine cattle being moved from the forest in the Fall.

Management in this multiple-use zone becomes very complex. It aims at allowing recreation and other land uses to co-exist. The area is large enough, and the kinds of lands varied enough, that as a general rule, other uses need not be prohibited in favor of recreation. Only a small part of the east slopes grows merchantable timber or useable forage, and the part used for oil wells and coal mines is a tiny fraction. Often the oil wells or the logging camps are unseen by recreationists. Only in a limited area would it be necessary to prohibit logging, grazing or mining in order to allow a rugged type of outdoor recreation. When a conflict occurs, a decision in favor of either recreation or commercial use, based upon principles mentioned earlier, must be reached.

Recreation in winter.



Beyond the multi-use zone, in the high mountain peaks and at the headwaters of the rivers, is a zone that lends itself to a primitive kind of recreation such as long-distance hiking, pack trips, cross-country skiing and hunting of mountain goats and bighorn sheep. This zone produces most of the pure clear water of the mountain streams and, therefore, its prime use is as a watershed. Watershed protection and improvement have priority but recreation of a dispersed outdoors type can be enjoyed without conflicts with water production.

Three wilderness areas have been set aside in the Conservation Area — Ghost River, Siffleur and White Goat. A primitive kind of recreation is their main purpose. There are also many areas not designated as wilderness areas where primitive recreation will be a major use.

Thus, we see that management of recreation varies from the intensive development to the primitive. In the intensive development zone, other uses are not allowed and many regulations must be enforced to conserve the recreational values. Here the people using the area can do much to help the cause of conservation by accepting these regulations and living by them.

Where recreational use goes along with the use of other forest resources, recreation may be less closely controlled. However, a cooperative spirit is much needed here where we use the land for recreation along with other uses. While we are seeking pleasure and revitalization of ourselves in the outdoors we must remember that other uses of the land contribute to the economy of the country. If we did not have a thriving economy we would not have the time, money and transportation necessary to enjoy the mountains. There must be give-and-take in the conflicts which arise between recreation and other uses, with the greatest total good ever foremost in our thinking rather than selfish desires.

Packing into the vastness of the primitive areas is becoming popular.

RESEARCH

A view of conservation on the east slopes of the Rockies would not be complete without a word on scientific research. There is such a need for accurate information and an understanding of the natural life processes for properly managing the resource, that research is necessary. The Canada Department of Fisheries and Forestry and its predecessors have carried out a forest research program for many years with most of it centered at the Kananaskis Forest Experiment Station. In recent years, with a realization of the importance of other resources of the forest lands, other Government agencies, both Federal and Provincial, have entered into scientific investigations. The first major watershed-management research program in Canada was set up on behalf of the Eastern Rockies Forest Conservation Board and involves more than a dozen government agencies in a cooperative effort. Included in this program are three basins where all aspects of forest hydrology are studied. Probably the best known of these basins is the Marmot Creek research basin on a tributary of the Kananaskis River. Much accurate information is coming from the investigations and the future management of the mountain lands may be greatly improved because of today's research.

One of five stream measuring stations in the Marmot Creek research basin.



CONSERVATION AND PEOPLE

Conservation is everybody's business. The natural resources of the country and how they are used determine the country's wealth. The Rocky Mountains contribute to the wealth and happiness of the people of Canada. Each should do his part to see that there is no waste, no destruction, but optimum use of all the resources. We need to appreciate the value of all the resources; those material resources like wood, oil and coal which contribute to our economic welfare, the intangible things like the beauty of a mountain lake or a fine ski slope which give enjoyment to people, as well as the water which is so essential to both our economic structure, our enjoyment and our living comfort. If we fail to make use of any one resource our total wealth falls short.

When conservation of things beautiful and well-loved is considered there is a tendency to

become emotional. It is difficult to think hard-headedly about a shimmering alpine lake which one discovered on a trip back onto a little-known plateau, or a fawn and doe that come down to drink at the brook behind the cabin. But these make up part of the biological community of the mountains and its environment. And furthermore, what is important to one may not be to another. The hunter wants maximum animal production but even different hunters disagree on the access and hunting conditions. One wants many roads and trails so that he can drive into the hunting country and haul his deer out in a car while his neighbor abhors that kind of hunting and wants the entire area kept as a wilderness with only trails for hunting on foot or by pack-horse outfit. Still another neighbor may dislike the killing for sport and would like conditions ideal for camera hunting and enjoying the friendly presence of deer and elk.

There is also a tendency to associate conservation only with preserving those things which add to the beauty and aesthetic enjoyment and to dis-

regard the economic importance of all the resources. Our economic welfare depends to a great extent upon the use of our natural resources. Calgary's prosperity, for example, is partly a result of the petroleum industry; and several of our best gas fields lie within the mountains and foothills.

Probably your neighbors, a family of eight, depend upon their income from a bread winner who operates a "cat" on a well-drilling crew who, to your disgruntlement, is drilling a gas well in your favorite area.

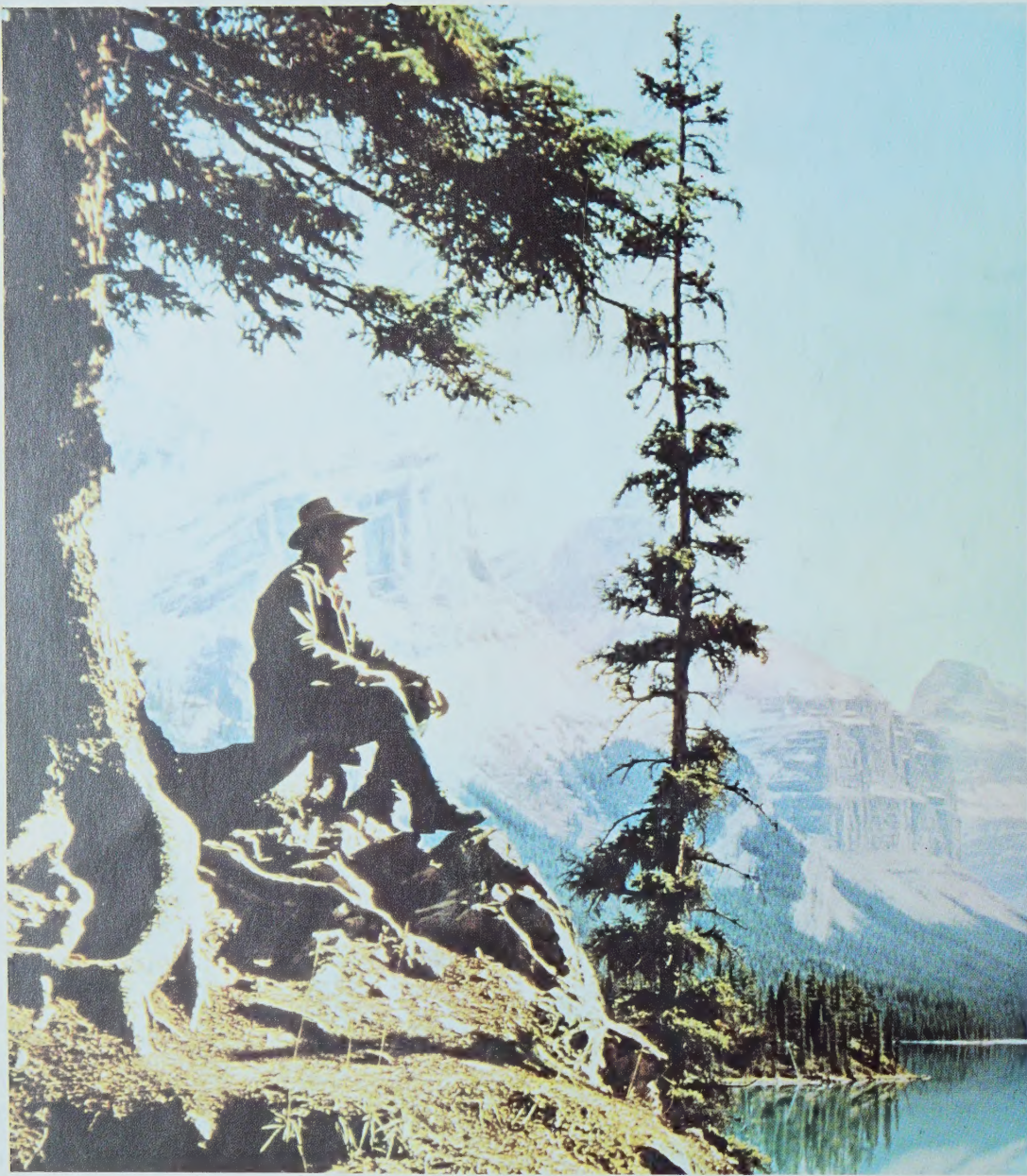
Conservation should not be emotional but must be based upon common sense management which uses the best methods which science can provide. Economics must play a part and we should not expect to enjoy what we are unwilling to pay for. Recreation costs money, where lumber mills or gas wells bring income to the community. We must remember also, that there are many points of view as to how mountain lands should be used and the decision makers should have in mind the total goods and services which the land may yield.

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CONSERVING A WATERSHED

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Man finds solitude and aesthetic stimulation in the high country.